

CLAIMS

A method of reconstructing tomography images comprising:

acquiring data on the geometric coordinates of detection of individual radiation events;
separately distributing a weight of each of the individual radiation events along a line

of flight associated with the event determined from the acquired data on the geometric
coordinates of detection of the individual event; and

iteratively reconstructing the image based on the distributed weights.

2. A method according to claim 1 wherein the weights are distributed in voxels along the
line of flight and wherein the weight of a particular event is distributed based on the
probability that an event occurred in particular voxels.

3. A method according to claim 1 ~~or claim 2~~ wherein the line of flight of an event is
determined based on the position at which the event was detected on a detector and the
acceptance direction of a collimator through which the detector receives radiation associated
with the events.

4. A method according to claim 1 ~~or claim 2~~ wherein the line of flight of an event is
determined by the position on a detector on which the event is detected and the location of the
source of radiation associated with the event.

5. A method according to claim 1 ~~or claim 2~~ wherein the line of flight associated with an
event is determined by detection of two coincident photons.

6. A method according to ^{claim 1} ~~any of the preceding claims~~ wherein iteratively reconstructing
the image comprises applying an iterative expectation maximization (EM) method on the data
in sub-sets.

7. A method according to claim 6 wherein the individual events form the separate sub-
sets.

8. A method according to claim 6 ~~or claim 7~~ wherein the sub-sets are formed based on the
time of acquisition of events.

9. A method according to claim 6 wherein the sub-sets are formed from unrelated events.

10. A method of reconstructing tomography images comprising:
acquiring data on the geometric coordinates of detection of individual radiation events;
and

5 applying an iterative expectation maximization (EM) method on the data in sub-sets
which are formed based on the time of acquisition of the data on the geometric coordinates of
detection of the events.

claim 6 or claim 10
A 11. A method according to ~~any of claims 6-10~~ wherein the subsets consist of data having
10 less than a 180 degree view angle.

claim 6 or claim 10
A 12. A method according to ~~any of claims 6-11~~ wherein iterations of the EM method are
performed prior to the acquisition of data having a 180 degree angle of view.

claim 6 or claim 10
A 13. A method according to ~~any of claims 6-12~~ wherein iterations are commenced on
15 receipt of the first detected event.

claim 6 or claim 10
A 14. A method according to ~~any of claims 6-13~~ comprising displaying an evolving image
based on successive iterations iterative method on a display device.

claim 6 or claim 10
A 15. A method according to ~~any of claims 6-14~~ and including determining if a study should
20 be terminated based on the image quality of an image after an iteration.

claim 6 or claim 10
A 16. A method according to ~~any of claims 6-15~~ wherein intermediate images are filtered
25 with a smoothing filter between iterations of the EM method.

claim 6 or claim 10
A 17. A method according to ~~any of claims 6-15~~ wherein intermediate images are filtered
with a noise reducing filter between iterations of the EM method.

claim 6 or claim 10
A 18. A method according to ~~any of claims 6-17~~ wherein data is reused in subsequent
30 iterations of the EM algorithm.

claim 1 or claim 10
A 19. A method according to ~~any of the preceding claims~~ wherein the image is a three
dimensional image.

20. A method according to ^{claim 1 or claim 10} ~~any of the preceding claims~~ wherein the iterative method comprises reconstructing from the events without forming two dimensional data sets.

21. A method according to ^{claim 1 or claim 10} ~~any of the preceding claims~~ wherein the iterative method comprises reconstructing from the events without forming sinograms for slices of the three dimensional image.

22. A method of reconstructing tomography images comprising:
acquiring data on the geometric coordinates of detection of individual radiation events;
and
iteratively reconstructing a three-dimensional image from the unbinned individual radiation events.

23. A method according to claim 22 wherein reconstructing the image comprises utilizing an expectation maximization (EM) method acting on individual unbinned events.

24. A method according to ^{claims 1, 10 or 22} ~~any of the preceding claims~~ wherein the radiation events are nuclear emission events and the images are emission tomography images.

25. A method according to ^{claims 1, 10 or 22} ~~any claims 1-24~~ wherein the radiation events are positron decay events and wherein the images are PET images.

26. A method according to ^{claims 1, 10 or 22} ~~any of claims 1-24~~ wherein the radiation events are represented by photons which have passed through a subject and wherein the images are transmission tomography images.

27. A method according to claim 26 wherein the radiation events are nuclear disintegrations and wherein the images are nuclear transmission tomographic images.

28. A method according to claim 26 wherein the radiation events are X-rays and wherein the images are X-ray CT images.

29. A method according to ^{claims 1, 10 or 22} ~~any of the preceding claims~~ wherein the line of flight associated with the radiation events form a fan beam.

30. A method according to ^{claims 1, 10 or 22} ~~any of claims 1-28~~ wherein the lines of flight associated with the events form a cone beam.

31. A method of reconstructing positron emission tomography (PET) images comprising:
acquiring data on the geometric coordinates of detection of individual positron emission tomography events utilizing a plurality of spatially continuous area detectors; and
reconstructing the image utilizing an expectation maximization (EM) method acting on individual unbinned events.

32. A method according to claim ³¹ ~~30~~ wherein the spatially continuous detectors are substantially planar detectors.

33. A method of reconstructing positron emission tomography (PET) images comprising:
acquiring data on the geometric coordinates of detection of individual positron emission tomography events utilizing a plurality of substantially planar area detectors; and
reconstructing the image utilizing an expectation maximization (EM) method acting on individual unbinned events.

34. A method according to any of claims 31-33 wherein the plurality of detectors consists of two such detectors.

35. A method according to any of claims 31-³³ ~~34~~ wherein the images are three dimensional images.